Resuscitation (2007) 74, 276–285

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TRAINING AND EDUCATIONAL PAPER

Prospective, randomized trial of the effectiveness and retention of 30-min layperson training for cardiopulmonary resuscitation and automated external defibrillators: The American Airlines Study☆

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Received 14 November 2006; received in revised form 11 December 2006; accepted 11 December 2006

KEYWORDS
American Heart Association;
Automated external defibrillator (AED);

Summary
Objective: A head-to-head trial was conducted to compare laypersons' long-term retention of life-saving psychomotor and cognitive skills learned in the traditional multi-hour training format for basic cardiopulmonary resuscitation and automated external defibrillator use to those learned in an abbreviated (30 min) course.
Methods: Laypersons were randomized to either: (1) the traditional multi-hour *Heartsaver-Automated External Defibrillator®* (*Heartsaver-AED®*) group; or (2) the

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at 10.1016/j.resuscitation.2006.12.017.

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0300-9572/$ – see front matter
doi:10.1016/j.resuscitation.2006.12.017

Cardiopulmonary resuscitation (CPR);
Chest compression;
Manikin;
Training;
Utstein;
Ventilation;
Adult learning;
Sudden cardiac death;
Cardiac arrest;
Rescue;
First aid

30-min course group (cardiopulmonary resuscitation, choking, and automated external defibrillator use). Immediately after training, and at 6 months, participants were provided identical individual testing scenarios. In addition to audio–video recordings, computerized recordings of compression rate/depth, ventilation rates, and related pauses were obtained and subsequently rated by blinded reviewers.

Results: Performance following 30-min training was either equivalent or superior ($p < 0.007$) to the multi-hour *Heartsaver-Automated External Defibrillator* training in all measurements, both immediately and 6 months after training. Although retention of certain skills deteriorated over the 6 months among a significant number of participants from both groups, 84% of the 30-min training group still was judged, overall, to perform cardiopulmonary resuscitation adequately. Moreover, 93% still were performing chest compressions adequately and 93% continued to apply the automated external defibrillator and deliver shocks correctly.

Conclusions: Using innovative learning techniques, 30-min cardiopulmonary resuscitation and automated external defibrillator training is as effective as traditional multi-hour courses, even after 6 months. Thirty-minute courses should decrease labor intensity, demands on resources, and time commitments for cardiopulmonary resuscitation courses, thus facilitating more widespread and frequent retraining.

Introduction

The American Heart Association (AHA) basic life support *Heartsaver®* course is the most widely recognized traditional model for training laypersons to perform basic adult cardiopulmonary resuscitation (CPR).[1] To support the CPR techniques being taught, the AHA has based the course on both scientific research and international consensus.[2] Also, to support quality assurance, AHA-certified instructors are required for both didactic and skills practice portions of the course.[3] Enough instructors are made available so that, during the hands-on skills training, an AHA-certified trainer is assigned to work with no more than six to eight trainees per session. While the AHA *Heartsaver®* course, its predecessors, and other similar training efforts have led to life-saving effects worldwide,[1,4] these traditional courses have often been considered both lengthy and labor intensive.[3,5] Typically lasting 3 to 4 h, much of the course time is consumed with didactics, leaving little time for skills practise. In addition, considering the number of certified instructors and specialized manikins required, traditional CPR courses can pose significant logistical and even financial barriers, especially when large groups are being trained.[5,6]

Although the didactic information is relatively simple and often cognitively related to CPR practice, it may also dilute and even confuse the central mission of CPR skills acquisition.[7] In addition, because up to eight trainees can be assigned to one skills practise instructor, each of the students must take turns at practising on the manikins, leading to inefficient use of time.

Recognizing these issues, alternative methods of CPR instruction have been proposed in recent years, including video-based self-instruction (VSI) using contemporary adult learning techniques.[8,9] Preliminary studies comparing VSI to traditional CPR training have all found VSI training to be at least as effective as, if not better than, traditional CPR training in terms of learning skills.[8,9] Such courses not only deal with the problem of labor intensity for training personnel, but they also require much less time to conduct.[7,9,10–13] For example, a recent study by Lynch et al.[9] demonstrated that a 22-min AHA VSI course resulted in better overall CPR performance compared to the standard AHA *Heartsaver®* course.

Although the abbreviated CPR courses clearly show promise, the long-term retention of CPR skills has not yet been evaluated sufficiently and the key skills of first aid for the choking victim and automated external defibrillator (AED) operation also were not included in those preliminary studies.

Therefore, the purpose of the present study was to conduct a prospective, randomized, head-to-head trial that compared the effectiveness and retention of the traditional 3 to 4 h *Heartsaver-Automated External Defibrillator®* (*Heartsaver-AED®*) course for adult CPR and AED use to a 30-min course that includes a 20-min VSI for basic life support CPR skills and a 5-min demonstration of AED operation. Specifically, the two training methods were to be evaluated not only in terms of skills performance immediately after the training, but also at retesting 6 months later, a time-line considered to be critical for indicating the retention of CPR skills.

Methods

Institutional Review Board and study subjects

The protocol was approved by the Institutional Review Board at our institution. Volunteer study subjects were employees at American Airlines headquarters in Ft. Worth, Texas, where all training and testing was conducted. Written informed consent was obtained for their participation, videorecording, and retesting.

Recruitment and randomization

Subjects were recruited by electronic mail and posted flyers. Respondents were informed of potential time commitments of up to 5 h. Only those without previous CPR training or whose last course was more than 5 years prior to the study were eligible. Upon course arrival, participants completed a brief survey of basic demographic data including name, age, sex, job title, education level, contact information, and the time of any previous CPR training.

Over seven study months (07/04 through 02/05), recruited subjects were given a unique identification number that determined their randomization to either the CPR in 30 min (C30) course or the standard 3 to 4 h adult *Heartsaver-AED*® (HS-AED) training. Randomization was accomplished using a computer-generated, online service.[14] Only certain study investigators (and no evaluators) had access to confidential number-matching identifiers for the subjects, including preliminary surveys, consent documents, and log sheets.

Short course (C30)

The C30 course consisted of a 30-min period that included the following: (1) a 23-min digital video disk (DVD) developed by the AHA demonstrating basic adult CPR skills including recognition of signs of life, calling for help (calling 911), opening the airway, rescue breaths, and chest compressions (Table 1); (2) a 3-min discussion and demonstration of the recognition of choking and the corresponding abdominal thrust maneuver; and (3) a single 5-min demonstration of the use of an AED. The instruction for these last two components (choking maneuvers and AED use) were performed by the session facilitator and subjects were not asked to demonstrate or practise them during the training. While HS-AED subjects practiced with an AED during training, C30 subjects did not touch an AED during the demonstration. The first time they actually handled and used the AED was during testing.

Table 1 Programme contents of the 23 min video-based self-instruction (VSI) for basic cardiopulmonary resuscitation (CPR) techniques

1. Introduction (2 min, 30 s)
2. Instructions for assembling Mini-Anne manikin (40 s)
3. Instructions and practice for chest compressions (2 min)
4. Instructions and practice for opening airway and delivering ventilations (2 min, 45 s)
5. Review and practice step 3—4 together, 4 cycles of CPR* (2 min, 20 s)
6. Instruction and practice on "shake and shout", calling for help, checking for "signs of life", and 4 cycles of CPR* (4 min, 25 s)
7. Practice complete cycle** with 8 cycles of CPR* (3 min, 30 s)
8. Practice of complete cycle** with 8 cycles of CPR* and assistance of CPR coach (3 min, 50 s)
9. Conclusion (1 min)
Total number of CPR cycles: 24
Exact time elapsed: 23 min, 25 s

* One CPR cycle includes 2 breaths and 15 chest compressions.

** A *complete cycle* includes "shake and shout," calling for help, checking for "signs of life" (breathing or movement), and the administration of CPR.

Subjects randomized to the C30 group were provided an AHA *Family and Friends CPR Anytime*® kit,[15] including: (1) the DVD; (2) an inflatable Mini-Anne® manikin (Laerdal Medical Corporation, Wappingers Falls, New York); (3) a "CPR coach" (*Laerdal Medical Corporation*), a device to help provide real-time audio feedback on the depth and rate of chest compressions; (4) knee pads; and (5) alcohol wipes.[9] For the purposes of this study, they were not allowed to keep any of the materials in the video-based self instruction (VSI) kit.

Traditional *Heartsaver-AED*® course

In addition to an AHA instruction booklet, subjects randomized to the HS-AED course attended a standard 3-h session for adult CPR, including: (1) didactic lectures supplemented by related video-based instruction; (2) practise of basic CPR skills; (3) first aid for choking; and (4) instruction in AED use. The instructors were AHA-certified HS-AED instructors who taught the course in the standard manner without improvisation. The study was performed just prior to the release of the 2005 revised AHA CPR guidelines. Therefore, the compression-ventilation ratio for both C30 and HS-AED groups

was 15:2, not the more recent recommendations for 30:2.

Instructors

For HS-AED, there was one instructor for every six to eight students during skills practise. To limit variability, only three different HS-AED instructors, all paramedic-firefighters from the City of Carrollton Fire Department, were used during the entire study period. For the C30 group, there was one instructor for up to 29 students, usually one of three study investigators. The C30 instructors were actually considered ''facilitators'' as they were not allowed to give verbal instruction while the subjects watched the VSI and performed their skills. However, they were allowed to give occasional nonverbal assistance with psychomotor skills such as hand repositioning. The same C30 facilitator provided a cognitive, noninteractive demonstration for choking and AED use for all C30 courses in the study.

Skills evaluation

Following their respective courses, each of the subjects underwent a performance evaluation at one of several individual testing stations consisting of the examiner, video-recording equipment, and a *Laerdal® Resusci-Anne™* recording manikin on the floor. The life-sized manikin was connected to a laptop computer with *Laerdal® Skill-Reporting™* personal computer (PC) software.

Upon entering the room, subjects displayed their numbered study sheet in front of the activated recording device for 5 s and then were presented with the same testing scenario involving an ''unresponsive person'' (the manikin). Explaining that the person had just collapsed, the examiner then asked the subject to show what he or she would now do without further coaching or reaction. After three to four cycles of compression-ventilation performance, however, the examiner did tell the subject that an AED had become available, immediately handing the subject a testing AED. Subjects were dismissed within another 3 to 4 min following operation of the AED. Six months (±2 weeks) after the original test, all participants were recalled for identical reexamination.

Main measurements

The *Laerdal® PC Skill Reporting™* software recorded CPR performance variables for each subject tested including the rate of ventilation, total ventilations/min, mean tidal volume (mL), rate of chest compressions (prorated frequency over a minute when excluding pauses for ventilation), total chest compressions/min, mean chest compression depth (mm), and mean duty cycle, defined as the percentage of time spent in the compression phase versus the total time interval measured from the start of one compression to the start of the next compression. The pause-for-ventilation interval, defined as time elapsed between chest compressions (in seconds), was also measured and recorded. Spreadsheets of the data from all participants in each group were recorded automatically, averaged, and reported using the specialized software.

At a separate time and place, the video recordings were reviewed by one of four different evaluators, all AHA-certified instructors who were blinded to group assignment. The evaluators were not involved in the training sessions and had no contact with the subjects. A standardized scale, derived from applicable Utstein guidelines,[16] was used to evaluate: (1) recognition of cardiac arrest; (2) call for help; (3) ventilation technique; (4) hand position; and (5) chest compressions. Each subject received either an ''adequate'' or ''inadequate'' grade for each of these key elements. In addition, the evaluators judged whether subjects used the AED correctly, including appropriate AED pad placement, not touching the manikin during analysis and shock, and giving a shock appropriately when indicated.

Statistical analysis

Analysis of variance (ANOVA) tests were used for continuous variables and Chi-square tests for nominal variables; alpha was set at 0.05 ($p < 0.007$ with Bonferroni correction).

Results

During the 7-month study period, 155 subjects were randomized to the C30 and 139 to the HS-AED groups; however, only 151 completed the C30 training and 119 completed the HS-AED course. Twenty subjects who were randomized to HS-AED stated that they did not have time to stay for the longer course and were not enrolled. Four individuals randomized to C30 were not included in the analysis: 3 wanted the HS-AED ''certification'' and 1 person was not tested due to physical limitations. For the 6-month follow-up, there was an identical attrition rate (33%) in both the C30 group and HS-AED groups. The average length of the C30 course was 29 min, including only 6 min for the choking and AED demon-

Table 2a Comparisons of the various demographic characteristics of the subjects completing the half-hour (C30) and the traditional *Heartsaver-AED®* (HS-AED) basic cardiopulmonary resuscitation (CPR) courses

	C30 ($n=151$)	HS-AED group ($n=119$)	p-value
Age (years)	44.1 ± 9.8	45.1 ± 9.9	0.42
Gender (female)	67%	70%	0.61
Highest education			
High school	23%	18%	0.35
College	77%	82%	
Employment			
Non-management	65%	75%	0.10
Management	35%	25%	
Prior CPR training (>5 years previously)	45%	36%	0.14

Table 2b Comparisons of the various demographic characteristics of the subjects completing retesting 6-months after receiving initial training with the half-hour (C30) and the traditional *Heartsaver-AED®* (HS-AED) basic cardiopulmonary resuscitation (CPR) courses

	C30 ($n=100$)	HS-AED group ($n=79$)	p-value
Age (years)	45.3 ± 9.6	44.0 ± 9.4	0.40
Gender (female)	68%	75%	0.27
Highest education			
High school	21%	13%	0.35
College	78%	87%	
Employment			
Non-management	63%	73%	0.25
Management	37%	27%	
Prior CPR training (>5 years previously)	52%	36%	0.07

strations, while the average length of the HS-AED course was approximately 3 h.

There were no significant demographic differences between the C30 and HS-AED groups (Table 2a), either at the initial training or at the 6-month follow-up (Table 2b). Although entry criteria allowed for persons who had taken previous CPR courses more than 5 years earlier, and there

Table 3 Immediate post-training and 6-month follow-up comparisons of the half-hour (C30) and the traditional *Heartsaver-AED®* (HS-AED) basic cardiopulmonary resuscitation (CPR) training courses using continuously recorded manikin data documenting the key performance variables for simulated CPR scenarios (mean ± S.D.)

	Immediately after training			6-month follow-up		
	C30 ($n=151$)	HS-AED ($n=119$)	p-value	C30 ($n=100$)	HS-AED ($n=79$)	p-value
Mean number of breaths provided each minute	6.0 ± 1.8	5.4 ± 3.9	0.09	5.8 ± 4.5	5.6 ± 3.9	0.87
Mean tidal volume (liters)	1.07 ± .37	0.94 ± .47	0.008	0.88 ± .57	0.80 ± .52	0.33
Mean compression rate (extrapolated rate/min)	100 ± 18	104 ± 25	0.07	95 ± 25	92 ± 28	0.43
Mean number of compressions provided each minute	49 ± 9	50 ± 15	0.68	47 ± 12	43 ± 19	0.10
Mean compression depth (mm)	43 ± 9	44 ± 8	0.39	45 ± 10	43 ± 9	0.26
Mean duty cycle (% of time in compression phase)	40 ± 7	40 ± 7	0.74	36 ± 8	38 ± 7	0.06

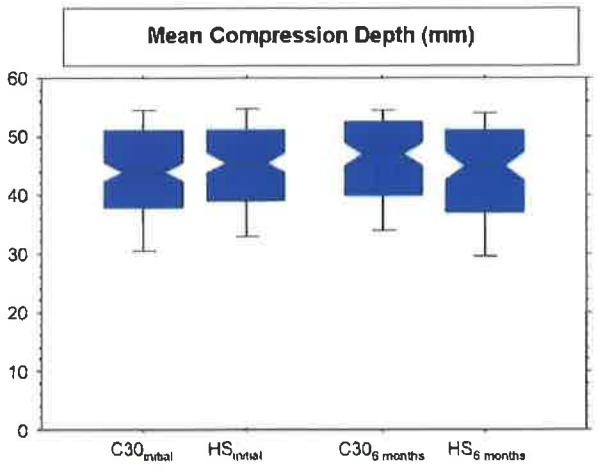

Figure 1 A comparison of mean compression depth for the C30 and the *Heartsaver-AED®* (HS) groups during the initial testing and 6-months later. Each box plot shows the 95% confidence interval around the median (notch), 18th, 25th, 50th (median), 75th, and 90th percentiles.

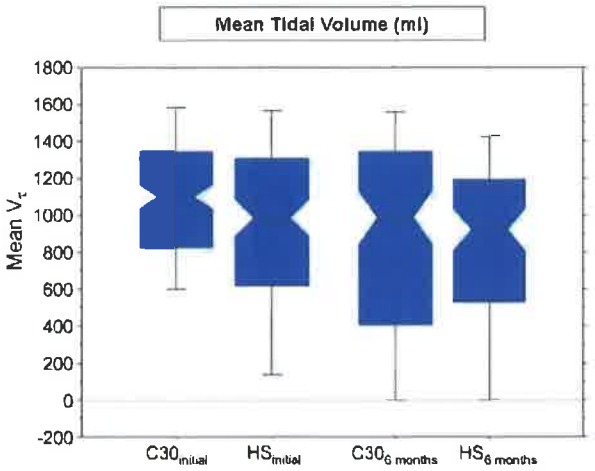

Figure 2 A comparison of the mean tidal volume (V_T) between the C30 and the *Heartsaver-AED®* (HS) groups during the initial testing and 6-months later. Each box plot shows the 95% confidence interval around the median (notch), 10th, 25th, 50th (median), 75th, and 90th percentiles.

was a trend for more of these persons in the C30 group, almost all of these persons had taken courses more than 10—20 years previously and there were no differences in any of the performance results both initially and at 6 months, when the groups were stratified by previous training.

In the immediate post-training tests of CPR performance recorded on the computerized manikins, there were no significant differences between the C30 and HS-AED groups (Table 3), except for a trend toward a larger mean tidal volume in the C30 group (1.07 ± 0.37 versus 0.93 ± 0.47 liters, respectively; $p = 0.008$). Compared to their initial performance, at the 6-month follow-up testing, the C30 subjects provided: (1) less tidal volume, (2) a lower chest compression rate, (3) fewer chest compressions/min, and a shorter duty cycle. Likewise, the HS-AED subjects provided a lower compression rate and fewer compressions per minute. At 6 months, there were no significant differences between the two groups in any of the evaluation categories (Table 3, Figures 1 and 2).

Comparison of the video recording evaluations of the subjects' CPR skills during the initial post-training tests showed that the C30 group called "9-1-1" and provided "adequate ventilation" more frequently than the HS-AED group (Table 4). Otherwise, there were no significant differences.

Table 4 Immediate post-training and 6-month follow-up comparisons of the half-hour (C30) and the traditional *Heartsaver-AED®* (HS-AED) basic cardiopulmonary resuscitation (CPR) training courses in terms of the percentage of subjects in each group judged to perform the various CPR skills adequately using blinded video recordings of their performance

	Immediately after training			6-month follow-up		
	C30 ($n = 151$)	HS-AED ($n = 119$)	p-value	C30 ($n = 100$)	HS-AED ($n = 79$)	p-value
Assessed for responsiveness (%)	93	90	0.42	73	70	0.62
Called for 9-1-1 (%)	93	78	0.0003*	87	89	0.74
Adequate ventilation (%)	91	73	0.0001*	68	73	0.43
Correct hand placement (%)	93	96	0.27	84	85	0.88
Adequate compression depth (%)	96	98	0.25	93	89	0.31
Overall CPR performance (%)	96	99	0.085	84	78	0.35
Correct AED placement and delivery of shock (%)	98	92	0.013	93	91	0.63

* Statistically significant difference.

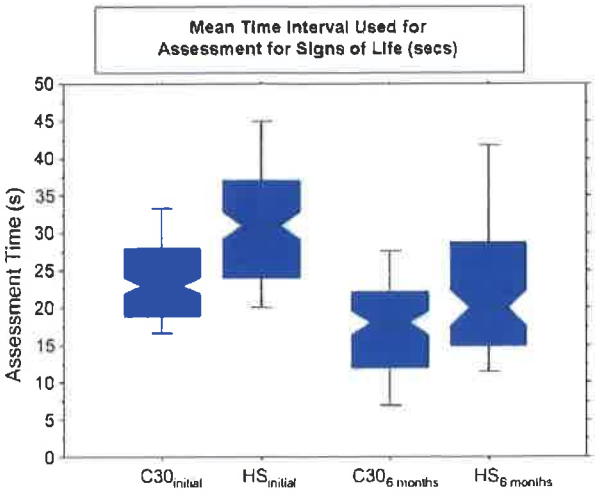

Figure 3 Comparison of the median assessment time for signs of life for the C30 and the *Heartsaver-AED®* (HS) groups during the initial testing after training and 6-months later. Each box plot shows the 95% confidence interval around the median (notch), 10th, 25th, 50th (median), 75th, and 90th percentiles.

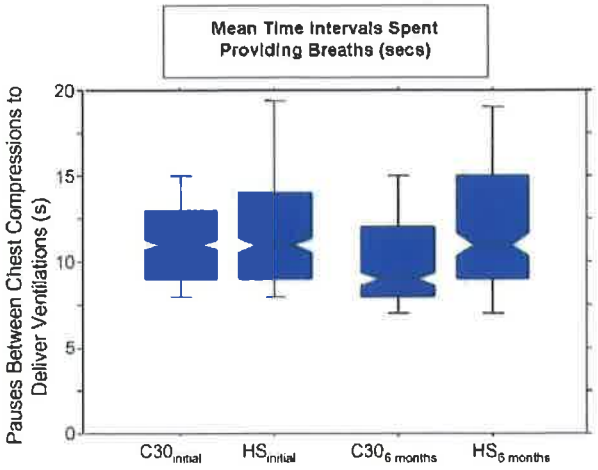

Figure 4 Comparison between the C30 and the *Heartsaver-AED®* (HS) groups during the initial testing and 6-months later in terms of the mean time interval (in seconds) taken to pause chest compressions to deliver ventilations. Each box plot shows the 95% confidence interval around the median (notch), 10th, 25th, 50th (median), 75th, and 90th percentiles.

When compared to the initial tests for the C30 group, in the 6-month follow-up evaluations a significantly lower percentage of subjects assessed responsiveness (73% at 6 months versus 93% initially; $p < 0.0001$; Table 4, Figure 3) or gave adequate ventilation (68% versus 91% initially; $p < 0.0001$). Overall, a smaller percentage of subjects (84% versus 96% initially; $p = 0.001$) were judged to have provided adequate CPR (Table 4).

In their 6 month evaluation, a significantly lower proportion of HS-AED subjects: (1) assessed responsiveness (70% at 6 months versus 90% initially; $p = 0.0003$; Table 4, Figure 3), (2) had correct hand position (85% versus 96%; $p = 0.007$), (3) used adequate compression depth (89% versus 98%; $p = 0.003$), and (4) were judged to give overall adequate CPR (78% versus 99% initially; $p < 0.0001$), when compared to the testing immediately after training (Table 4).

Despite these various decreases in skills retention over 6 months, no significant differences were observed between the two groups (Table 4) and only one-sixth of the C30 subjects were judged to perform inadequate CPR overall at the half year mark. Moreover, 93% of all C30 subjects were still considered to be performing adequate chest compressions 6 months after the training (Table 4). Also, both at the initial test and at 6 months, the HS-AED subjects took one-third more time (8 and 6 s, respectively; $p < 0.0001$) to assess for signs of

Table 5 Immediate post-training and 6-month follow-up comparisons of the half-hour (C30) and the traditional *Heartsaver-AED®* (HS-AED) basic cardiopulmonary resuscitation (CPR) training courses in terms of time intervals (mean ± S.D. in seconds) used for assessment of signs of life, pauses for ventilation between cycles of chest compressions and time to apply an automated external defibrillator (AED) and deliver the first shock

	Immediately after training			6-month follow-up		
	C30 ($n = 151$)	HS-AED ($n = 119$)	p-value	C30 ($n = 100$)	HS-AED ($n = 79$)	p-value
Time for assessment of signs of life	24 ± 7	32 ± 13	<0.0001	18 ± 10	24 ± 13	<0.0001
Pause for ventilation between cycles of chest compressions	11.5 ± 3.3	13.5 ± 6.1	<0.0001	10.9 ± 4.5	12.5 ± 5.4	<0.0001
Time to apply AED and deliver a shock	77.6 ± 20.9	72.9 ± 22.3	0.08	67.0 ± 20.7	62.6 ± 15.3	0.13

life (Table 5, Figure 3), and they took significantly more time (about 2 s more) with the average pause between chest compressions to perform ventilations ($p < 0.0001$; Table 5, Figure 4). Strikingly, both groups took one third less time ($p = 0.09$) to assess for signs of life at 6 months than they had at the initial training (Table 5, Figure 3).

In terms of AED use, C30 subjects placed the AED pads and delivered a shock correctly in 98% of the cases compared to 92% ($p = 0.03$) of their HS-AED counterparts (Table 4). There still were no significant differences at 6 months. Also, there were no significant differences between the C30 and HS-AED groups in terms of the time taken to perform these actions (Table 5). Interestingly, however, both the C30 and HS-AED participants took significantly less time to perform these AED procedures at the 6-month mark ($p < 0.001$).

Discussion/conclusion

This study confirmed that a 30-min CPR training course for laypersons, including instruction in basic adult life support CPR techniques and AED use, was at least as effective in terms of skills performance as the traditional 3 to 4 h training courses for these respective skills. Most importantly, the retention of these CPR and AED skills at the critical 6-month mark was not significantly different, and, if anything, there were trends indicating advantages for the C30 course, particularly in terms of AED use.

The C30 course was developed using innovative principles of adult learning for CPR known as ''synchronous self-instructional learning,'' a ''watch-while-you-practise'' approach. Focusing on the critical psychomotor skills for CPR, it is action-oriented and involves more hands-on practise than traditional courses.[3,9] Even though total instruction time for CPR in the C30 DVD is 22 min, the student is actually practising CPR skills almost continuously for 17 min.[3]

In traditional courses, the availability of both certified instructors and the larger, less-portable traditional manikins pose further limitations on practise time. Traditional courses typically have multiple students taking turns practicing CPR on the same manikin. The time-efficiency for individual practice therefore typically increases six-fold in the C30 course since the students have their own manikin. This advantage is even more pronounced when training large groups in one setting. Through the DVD, mass training can now be readily facilitated, even with nominal numbers of facilitators.

Very limited intervention was necessary by the facilitators while the subjects participated in the C30. Most of the interactions involved brief, one-time correction of hand placement or head positioning. The ratio of facilitators to students was as high as 1:29. Since choking and AED components were simple demonstrations, a video recording of such training would likely provide the same successful outcomes found in this investigation, although this should be studied directly.

While preliminary investigations have demonstrated the relative effectiveness, or even superiority, of VSI compared to traditional methods of teaching CPR,[7,9,10,12,13] the crucial component of skills retention has been lacking as are studies of short courses that also include procedures for the critical skills for choking and AED operation. One recent study did compare VSI CPR alone to a 6-h CPR course and found no significant difference in CPR performance when assessed 3 months after training.[8] In the current study the additional C30 facilitator-instructor demonstrations of the abdominal thrust (choking maneuver) and AED use were incorporated because both of these techniques were included in the control group training. While we did not study retention or even performance of the choking techniques, largely because of a lack of technical equipment to measure performance of this skill, we believe that this component is not only a critical skill, but should also be specifically studied in future investigations.

Retention of CPR psychomotor skills may decline as early as 2 weeks after initial training. Fossel et al. tested three groups of medical students, without prior warning, at various times after CPR training: (1) two to three weeks; (2) 1 year; and (3) 2 years.[17] Overall retention of CPR skills was poor, even in this group of individuals traditionally considered to be more inclined to remember these skills.[17] One study by Moser et al., evaluated the retention of CPR skills in family members of cardiac patients with the similar assumption that these individuals were better motivated to learn CPR. Overall, CPR retention was poor.[18] Chamberlain et al. found that retraining could provide protection against the decay of CPR skills when tested six to 9 months later. However, this finding was only significant in a small number of individuals.[19] In the current study, we chose 6 months as the reevaluation period because the half year mark is the recommended retesting interval suggested by the Utstein guidelines.[16]

General explanations for poor retention of psychomotor skills include inadequate instruction and too much cognitive material during CPR training,[20,21] whereas increased practise time with accompanying ''muscle-memory'' has been found to improve retention as does simplification of CPR skills.[22–25] Also, one study, found that sub-

jects were significantly better at remembering the sequence of skills later when taking simplified four-step CPR training compared to an eight-step sequence.[26] Accordingly, by standardizing the correct training (through VSI), focusing more on skills practice, simplifying the steps and reinforcing them in a reiterative manner, C30 was predictably able to enhance retention of the psychomotor skills. Furthermore, by being so much more portable, shorter in duration, and logistically easy to set up, C30 makes retraining on a regular basis more feasible, further enhancing long-term retention.

While these attributes of the C30 course provide some explanations for its success in facilitating the retention of the psychomotor skills of CPR, the same principle of simplification may also account for the ability of 93% of the participants to remember the cognitive skill of how to operate the AED 6 months later. In contrast to the HS-AED group, C30 students never touched an AED during training. The first time that they actually operated an AED was during testing. Therefore, the results of this study suggest that learning how to operate an AED is mostly a cognitive skill with very little, if any, psychomotor component. By simply stating (and restating) the three simple instructions, "(1) recognize the problem; (2) open the box; and (3) follow the instructions," this cognitive skill was retained just as well as with the lengthier hands-on practice provided to traditional course participants. Recognizing that the AED instruction was all cognitive (except for the actual testing itself), this important study finding creates significant opportunities for training using cognitive learning tools such as the internet and DVD VSI. More importantly, with this particular technology, the trainees do not need to remember the specific steps to operate it because they know that the audio prompts will lead them through the process. This simplicity may very well provide a sense of confidence that also may make would-be rescuers less reluctant to act in an actual cardiac arrest situation.

The major difficulty encountered in this investigation was getting subjects to return for retesting, largely because some had since left employment. Nevertheless, there was an equal rate of attrition (about one-third lost to follow-up) in both the C30 and HS-AED groups, and the comparison demographics of the remaining groups were identical, even among those who had had some exposure to CPR training in the distant past. Despite equality in randomization, 20 persons left the HS-AED group early on the training day and did not participate in training or testing. This attrition in the HS-AED group was a key finding of this study. Although they had been told prior to the day of training to commit up to 4 h of time, some of those assigned to the traditional course reported that they were leaving early because of true scheduling difficulties. While it is unlikely that this factor affected the results, it does underscore the premise that many people are unwilling to devote several hours to CPR training but they would be willing to commit a half-hour or so, making this early dropout rate in the HS-AED group a major finding of this study.

Conflict of interest statement

No author on this manuscript has any conflict of interest to report.

Acknowledgments

The authors wish to thank the leadership and employees of American Airlines, Ft. Worth, Texas, for their vision and support of efforts to advance life-saving care, especially Alex M. Wolbrink, MD, MS. They also extend their gratitude to the City of Carrollton, Texas, and its paramedic/firefighters who provided their expertise to this project; to the Laerdal Corporation, Wappingers Falls, New York, for development of equipment; and the American Heart Association, Dallas, Texas, for development of the C30 products.

Awards and Funding: The Laerdal Medical Corporation, Wappingers Falls, New York, supplied the CPR training kits, training manikins, related software, and videotaping equipment. Philips Medical Systems, Seattle, Washington, supplied the HeartStart Trainer Automated External Defibrillator training device and related equipment.

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